

**CLAIMS**

1           1.    A patterned roller for a manufacturing process, the  
2 patterned roller comprising:  
3                an axle;  
4                a cylindrical sleeve around the axle, the cylindrical  
5 sleeve coaxial with the axle;  
6                one or more patterned rings slidably engaged with the  
7 cylindrical sleeve and perpendicular thereto, each of the  
8 one or more patterned rings having a subpattern of a  
9 pattern of the roller in an outer edge, each of the one or  
10 more patterned rings having an inner edge shaped to  
11 slidably engage the cylindrical sleeve, the one or more  
12 patterned rings coaxial with the axle;  
13                a first end flange and a second end flange sandwiching  
14 the cylindrical sleeve and the one or more patterned rings,  
15 the first end flange and the second end flange coupled  
16 perpendicular and coaxial to the axle; and  
17                one or more fasteners coupled between the first end  
18 flange and the second end flange, the one or more fasteners  
19 to hold the first end flange and the second end flange  
20 together sandwiching the cylindrical sleeve and the one or  
21 more patterned rings.

1           2.    The patterned roller of claim 1, wherein  
2                the one or more patterned rings, each having the  
3 subpattern, form the pattern of the roller for rolling onto a  
4 surface of a sheet of material.

1           3.    The patterned roller of claim 1, wherein

2       the one or more fasteners are one or more pairs of nuts and  
3       bolts coupled together.

1       4.    The patterned roller of claim 1, further comprising:  
2            one or more spacer rings slidably engaged with the  
3       cylindrical sleeve and perpendicular thereto, each of the  
4       one or more spacer rings having an edge pattern of the  
5       pattern of the roller in an outer edge, each of the one or  
6       more spacer rings having an inner edge shaped to slidably  
7       engage the cylindrical sleeve, the one or more spacer rings  
8       coaxial with the axle.

1       5.    The patterned roller of claim 4, wherein  
2       the one or more patterned rings, each having the  
3       subpattern, and the one or more spacer rings form the pattern of  
4       the roller for rolling onto a surface of a sheet of material.

1       6.    The patterned roller of claim 4, wherein  
2       a pair of the one or more spacer rings sandwiches a  
3       patterned ring of the one or more patterned rings.

1       7.    The patterned roller of claim 1, further comprising:  
2            one or more rods parallel with the axle coupled  
3       between the first and second flanges, the one or more rods  
4       slidably engaged with the one or more patterned rings and  
5       perpendicular thereto;  
6            and wherein  
7            each of the one or more patterned rings having an  
8       opening to slidably engage the one or more rods and hold a  
9       fixed rotational position around the axle.

1        8.    The patterned roller of claim 1, wherein  
2            the cylindrical sleeve includes a guide slot parallel  
3            with the axle; and  
4            each of the one or more patterned rings includes a  
5            guide tab in an inner edge to slidably engage the guide  
6            slot and hold a fixed rotational position around the axle.

1        9.    The patterned roller of claim 1, further comprising:  
2            a motor to drive the roller;  
3            first and second bearings to support the roller, the  
4            first bearing located near a first end and the second  
5            bearing located near a second end of the axle; and  
6            a gear box coupled between the motor and the first  
7            end of the axle, the gear box having gearing to  
8            proportionally rotate the roller in response to rotations  
9            of a shaft of the motor.

1        10.   A roller stack for forming a pattern in a surface of a  
2        film, the roller stack comprising:  
3            a first roller; and  
4            a second roller, the second roller having a  
5            cylindrical pattern to roll over the surface of the film  
6            and form the pattern therein, the second roller including,  
7            a rotatable shaft,  
8            and  
9            one or more rings coupled in parallel together  
10          to the shaft, an outer edge of each of the one or more  
11          rings having a respective subpattern aligned together  
12          to form the cylindrical pattern;  
13          and

14           the film between the first roller and the second  
15           roller, the second roller to press against the surface of  
16           the film to form the pattern therein.

1           11. The roller stack of claim 10, further comprising:  
2           a third roller to cool the film.

1           12. The roller stack of claim 10, further comprising:  
2           a motor coupled to drive the rotatable shaft of the  
3           second roller,  
4           first and second bearings to support the second  
5           roller, the first bearing located near a first end and the  
6           second bearing located near a second end of the rotatable  
7           shaft; and  
8           a gear box coupled between the motor and the rotatable  
9           shaft, the gear box having gearing to proportionally rotate  
10          the second roller in response to rotations of the motor.

1           13. The roller stack of claim 12, further comprising:  
2           a third roller to cool the film.

1           14. The roller stack of claim 13, further comprising:  
2           a frame to rotatably support the first roller, the  
3           second roller and the third roller in parallel together.

1           15. A manufacturing system for the manufacture of an  
2           extruded film, the manufacturing system comprising:  
3           an extruder to receive solid raw materials, the  
4           extruder further to heat and extrude liquefied raw  
5           materials; and

6 an extrusion die to receive the liquefied raw  
7 materials, the extrusion die further to flatten the  
8 liquefied raw materials into a thin wide sheet of semi-solid  
9 raw materials; and

10 a roller stack to receive the thin wide sheet of semi-  
11 solid raw materials, the roller stack including,

12 a first roller and a second roller oriented to  
13 receive the thin wide sheet of semi-solid raw  
14 materials between them, the second roller further  
15 having a cylindrical pattern, formed out of one or  
16 more rings, to roll over a surface of the thin wide  
17 sheet of the semi-solid raw materials and form a  
18 pattern therein, the roller stack to output a thin

19 wide sheet of solid raw materials having the pattern;

20 a pair of nip rollers to pull on the thin wide sheet  
21 of solid raw materials to convey the thin wide sheet of  
22 solid raw materials; and

23 a windup roller to receive the thin wide sheet of  
24 solid raw materials and roll it up into a roll of sheeting.

1 16. The manufacturing system of claim 15, wherein  
2 the first roller to further cool the thin wide sheet of  
3 semi-solid raw materials.

1 17. The manufacturing system of claim 15, wherein  
2 the roller stack further includes  
3 a third roller to cool the thin wide sheet of semi-solid  
4 raw materials into the thin wide sheet of solid raw materials.

1 18. The manufacturing system of claim 15, wherein

2       the second roller presses against the surface of the thin  
3 wide sheet of semi-solid raw materials to form the pattern  
4 therein.

1       19. The manufacturing system of claim 15, wherein  
2       the second roller further has  
3               a rotatable shaft,  
4               a motor coupled to one end of the rotatable  
5       shaft to drive the rotatable shaft, and  
6               one or more rings coupled in parallel together  
7       to the shaft, in an outer edge each of the one or more  
8       rings having a respective subpattern aligned together  
9       to form the cylindrical pattern of the second roller.

1       20. A method of manufacturing a patterned film, the method  
2 comprising:  
3       providing raw materials into a liquefied form;  
4       shaping the liquefied form of raw materials into a thin  
5 sheet;  
6       rolling a patterned roller over a surface of the thin  
7 sheet, the patterned roller including one or more rings each  
8 having a respective subpattern of a cylindrical pattern of the  
9 patterned roller;  
10      and  
11      winding the thin sheet into a roll.

1       21. The method of claim 20, further comprising:  
2       cooling the thin sheet using a first chill roller and a  
3 second chill roller.

1       22. The method of claim 20, wherein,

2           a wind-up roller for the winding of the thin sheet into the  
3 roll.

1           23. The method of claim 20, wherein,  
2           an extruder die for the shaping of the liquefied form of  
3 the raw materials into the thin sheet.

1           24. The method of claim 20, wherein,  
2           an extruder for the providing of the raw materials into the  
3 liquefied form.

1           25. The method of claim 20, wherein,  
2           prior to the winding of the thin sheet, the method further  
3 comprises  
4           pulling the thin sheet.

1           26. The method of claim 25, wherein,  
2           a nip roller pair for the pulling of the thin sheet.

1           27. The method of claim 25, wherein,  
2           prior to the pulling of the thin sheet, the method further  
3 comprises  
4           redirecting the thin sheet.

1           28. The method of claim 27, wherein,  
2           an idler roller for the redirecting of the thin sheet.

1           29. A roll of extruded film formed by the method of  
2           extruding raw materials into a liquefied form;  
3           shaping the liquefied form of raw materials into a thin  
4 sheet;

5       rolling a patterned roller over a surface of the thin  
6 sheet, the patterned roller including one or more rings each  
7 having a respective subpattern of a cylindrical pattern of the  
8 patterned roller;

9       cooling the thin sheet;

10       and

11       winding the thin sheet into a roll.

1       30. A method of manufacturing a reflective film, the  
2 method comprising:

3       coupling a film into a roller stack;

4       rolling and pressing a corner cube pattern of a patterned  
5 roller into a surface of the film to form the reflective film,  
6 the corner cube pattern formed of subpatterns of one or more  
7 patterned rings; and

8       cooling the reflective film into a solid state.

1       31. The method of claim 30, wherein,

2       a chill roller for cooling the reflective film into the  
3 solid state.

1       32. The method of claim 30, further comprising:

2       pulling the film into the roller stack.

1       33. The method of claim 32, wherein,

2       the patterned roller is driven to pull the film into the  
3 roller stack.

1       34. The method of claim 30, wherein,

2        a first chill roller and the patterned roller for rolling  
3        and pressing the corner cube pattern of the patterned roller  
4        into the surface of the film to form the reflective film.

1        35. The method of claim 34, wherein,  
2        a second chill roller for cooling the reflective film into  
3        the solid state.

1        36. The method of claim 35, wherein,  
2        the roller stack includes the patterned roller, the first  
3        chill roller, and the second chill roller.

1        37. The method of claim 30, further comprising:  
2        pulling the reflective film out of the roller stack.

1        38. The method of claim 37, wherein,  
2        the second chill roller is driven to pull the reflective  
3        film out through the roller stack.

1        39. A reflective film formed by the method of  
2        coupling a film into a roller stack;  
3        rolling and pressing a corner cube pattern of a patterned  
4        roller into a surface of the film to form the reflective film,  
5        the corner cube pattern formed of subpatterns of one or more  
6        patterned rings; and  
7        cooling the reflective film into a solid state.

1        40. A roll of reflective laminate sheeting including a  
2        layer of reflective film formed by the method of  
3        coupling a film into a roller stack;  
4        rolling and pressing a corner cube pattern of a patterned  
5        roller into a surface of the film to form the reflective film,

6 the corner cube pattern formed of subpatterns of one or more  
7 patterned rings; and  
8 cooling the reflective film into a solid state.

1 41. An article of manufacture including a portion of a  
2 reflective film formed by the method  
3 coupling a film into a roller stack;  
4 rolling and pressing a corner cube pattern of a patterned  
5 roller into a surface of the film to form the reflective film,  
6 the corner cube pattern formed of subpatterns of one or more  
7 patterned rings; and  
8 winding the reflective film into a roll.

1 42. The article of manufacture of claim 41, wherein  
2 the article of manufacture is one or more of  
3 a license plate, a shoe, a highway sign, an  
4 article of clothing, a pavement marker, an automobile  
5 reflector, and a bicycle reflector.

1 43. A roll of film comprising:  
2 an optical film rolled up into a roll, the optical film  
3 including a first side having  
4 a plurality of columns of full corner cubes,  
5 each adjacent column of full corner cubes having  
6 a pattern of full corner cubes offset from the next,  
7 and  
8 a groove between each of the plurality of  
9 columns of full corner cubes.

1 44. The roll of film of claim 43, wherein  
2 the optical film further includes a second side having

3                   an adhesive to adhere the optical film to a  
4                   surface.

1           45. The roll of film of claim 44, wherein  
2           the second side of optical film further has  
3                   a release layer to protect the adhesive.

1           46. The roll of film of claim 43, wherein  
2           the full corner cubes in the first side reflect incident  
3   light, and  
4           the optical film further includes a second side having  
5                   a reflective layer to further reflect the  
6                   incident light.

1           47. The roll of film of claim 43, wherein  
2           the full corner cubes in the first side reflect incident  
3   light, and  
4           the first side of the optical film further has  
5                   a reflective layer to further reflect the  
6                   incident light.

1           48. The roll of film of claim 47, wherein  
2           the first side of the optical film further has  
3                   an adhesive to adhere the optical film to a  
4                   surface.

1           49. The roll of film of claim 43, wherein  
2           the plurality of columns of full corner cubes is a seamless  
3   plurality of columns of full corner cubes.

1           50. A reflective film comprising:  
2           an optical material formed into a body region and an

3 optical region, the body region to support the optical region;  
4 and

5 the optical region having N columns of corner cubes without  
6 seams, the optical region formed by  
7 rolling a patterned roller over a surface of a  
8 film, the patterned roller including N patterned  
9 rings.

1 51. The reflective film of claim 50, wherein  
2 the optical region further has M grooves interspersed  
3 between the N columns of corner cubes, and  
4 the optical region being further formed by the patterned  
5 roller further including M spacer rings.

1 52. The reflective film of claim 50, wherein  
2 the optical material is a thermoplastic.

1 53. A reflector to reflect an incident light source of an  
2 incident angle back at a reflective angle, the reflector  
3 including:  
4 a laminate having a reflective layer, the reflective layer  
5 including a surface comprised of  
6 N columns of full corner cubes without seams, each of the  
7 full corner cubes being shaped as a triangular pyramid, and  
8 M grooves, each groove separating a pair of columns of full  
9 corner cubes without seams.

1 54. The reflector of claim 53, wherein  
2 each full corner cube includes a base, a head, a tail, and  
3 three reflective surfaces joined at an apex.

1        55. The reflector of claim 53, wherein  
2        each full corner cube is a male corner cube.

1        56. The reflector of claim 53, wherein  
2        the full corner cubes are aligned in rows.

1        57. The reflector of claim 56, wherein  
2        the full corner cubes in even columns are aligned in rows  
3        from head to tail and the full corner cubes in odd columns are  
4        aligned in rows from tail to head.

1        58. The reflector of claim 53, wherein  
2        the laminate further includes an adhesive layer to couple  
3        the reflective film to a surface.

1        59. The reflector of claim 53, wherein  
2        the N columns of full corner cubes without seams and the M  
3        grooves are formed by  
4                rolling a patterned roller over a surface of a  
5                film, the patterned roller including N patterned rings  
6                and M spacer rings.

1        60. The reflector of claim 53, wherein  
2        the reflector is one or more of a license plate, a shoe, a  
3        highway sign, an article of clothing, a pavement marker, an  
4        automobile reflector, and a bicycle reflector.

1        61. The reflector of claim 53, wherein  
2        each of the full corner cubes is shaped as an  
3        asymmetrictriangular pyramid.

1           62. The reflector of claim 53, wherein  
2           each of the full corner cubes is shaped as a  
3   symmetrictriangular pyramid.